Space Weather Technical Forecast

Issued on Wednesday, 16 March 2022 at 01:03 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Moderate Solar activity with a chance of further M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours with a couple of M-Class flares observed from AR2965 Fai/Beta-gamma. This has exhibited some development of small spots to the north of the region, potentially causing the instability and the subsequent flare activity, despite some simplification elsewhere in the region. There are three numbered sunspot region on the disc in total, with the other two regions AR2970 Bxo/Beta and AR2976 Hsx/alpha both small and simple. A further sunspot region is also developing near the northeast limb. No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds speeds, as observed by DSCOVR at L1, have been at background to slightly elevated levels 360-430km/s, as the influence of the recent CME subsided. Density was at average or below average levels, below 10ppcc. The strength of the interplanetary magnetic field (IMF), Bt, gradually eased from Moderate levels (12nT), to become Weak (5nT) by 16/0000 UTC. The north-south component, Bz, was Moderately positive at first, near 10nT, with only brief periods of weakly negative field (southward). Phi angle was negative (towards the sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) measured at GOES 16 was very slightly above background, likely due to a far-sided flare from just over the southwest limb, but well below the S1 level and has now eased back towards background. The high energy electron flux (greater than 2 MeV) has been at background. The 24-hour integrated electron fluence was below the Active (1e8 integrated pfu) threshold. Observed fluence at 16/0000 UTC was 1.51e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate with an ongoing chance of M-class flares from AR2965.

Solar Wind / Geomagnetic Activity: There is one slow weak CME observed from a filament lift off the southern disc on 13 March. This will likely pass south of the Earth, but may give a glancing impact on day 2 (17th). No coronal hole sourced enhancements are currently expected during this period. Geomagnetic activity is likely to be predominantly Quiet, with the greatest chance of any significant increases in activity to Active (Kp4) if we do see the weak CME on Day 2 (17th).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain predominantly at background levels, although there is a slight chance of an increase in response to any larger flares that may occur. The high energy (greater than 2 MeV) electron flux is currently at background levels, however there is still the potential for an increase in flux through days 1 and 2 (16th and 17th), The electron fluence is likely to follow a rising trend if we see an electron response, but unlikely to reach the Active threshold, although this is low confidence.

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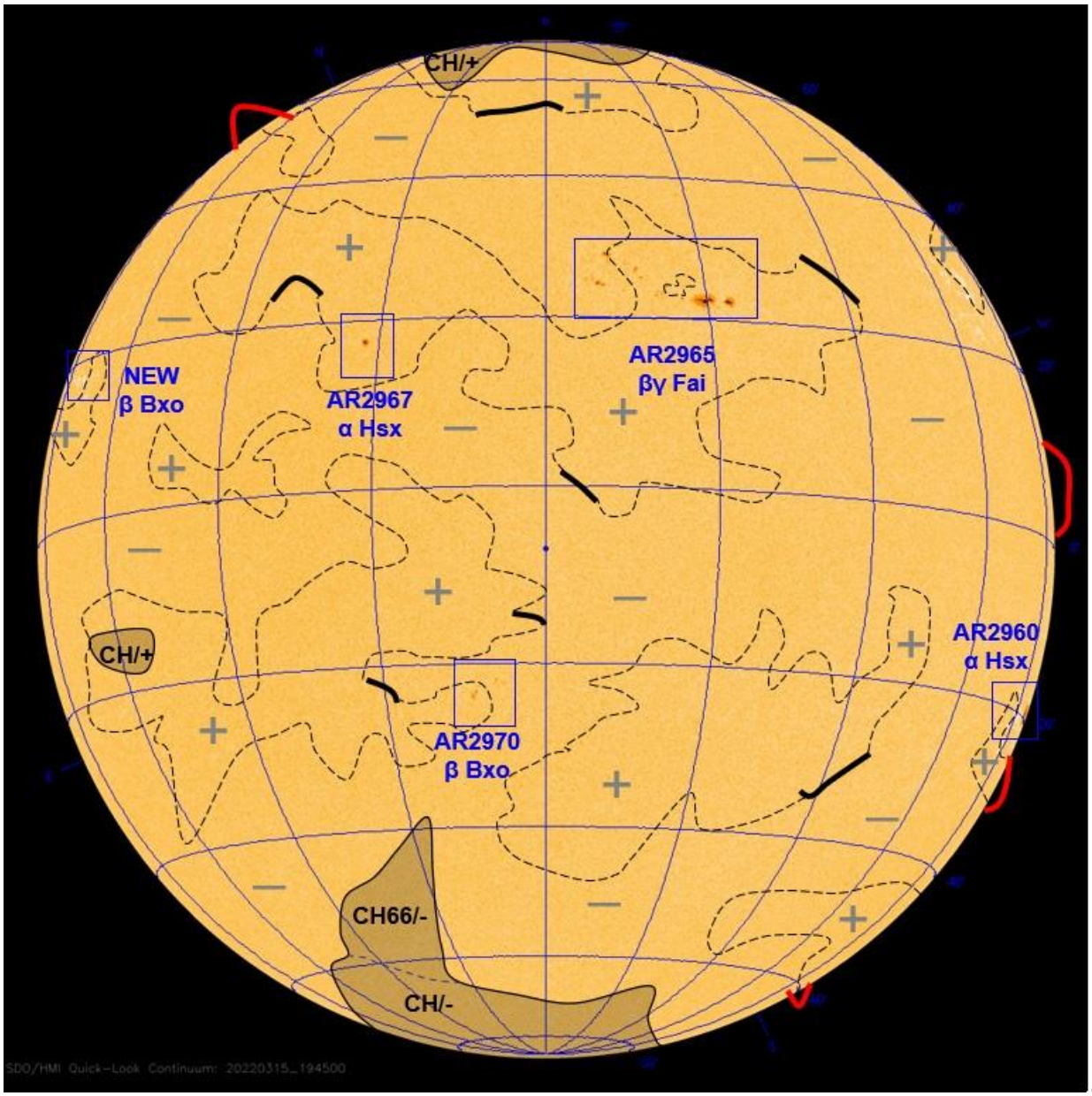
Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Recent CME enhancements have now eased, with solar winds at or near background. There is a CME expected to pass to the south of Earth on day 2 (17th), from a filament lift on the 13th. This has a low chance of bringing a glancing impact, and giving a chance of Unsettled to Active intervals and a slight chance of G1 Minor Storm intervals.

No other enhancements are expected with the next coronal hole fast wind arrival potentially on the 20th (day 5) from CH66/-, a northern extension of the southern crown coronal hole. Geomagnetic activity is expected to remain Quiet with only isolated Unsettled intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
13/2018	Partial	Filament	17W33S	380	Miss	Small chance of glancing blow on the 17th.

Figure 2: SDO aia-193 of previous rotation (left) and current (right) Southern hole more advanced on last rotation, with no Central disc CH on this occasion either

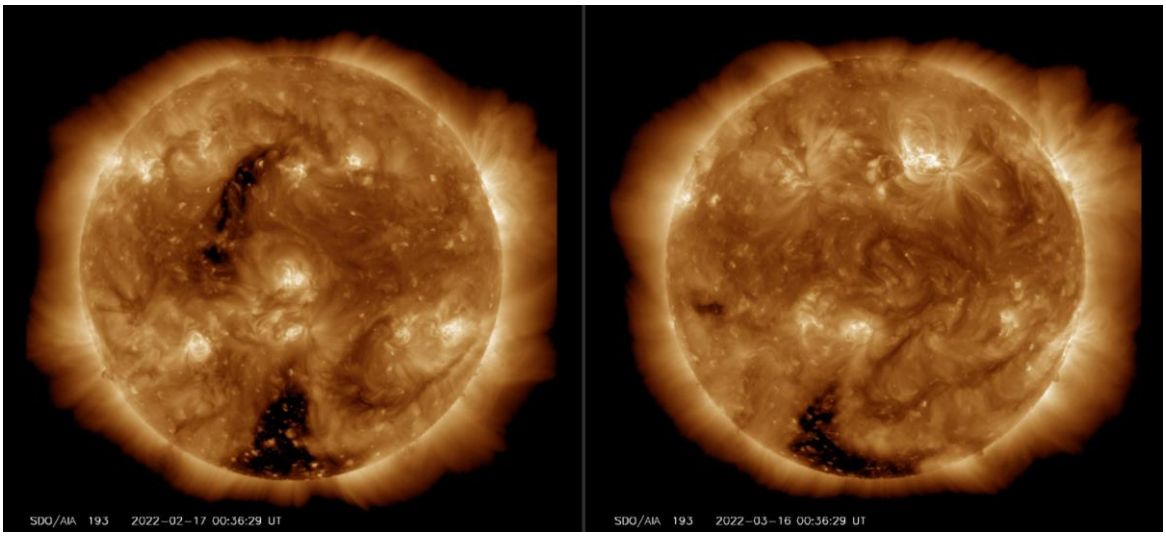

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Figure 3: Solar Wind Persistence Model Enhancement indicated likely too early given changes in coronal hole location.

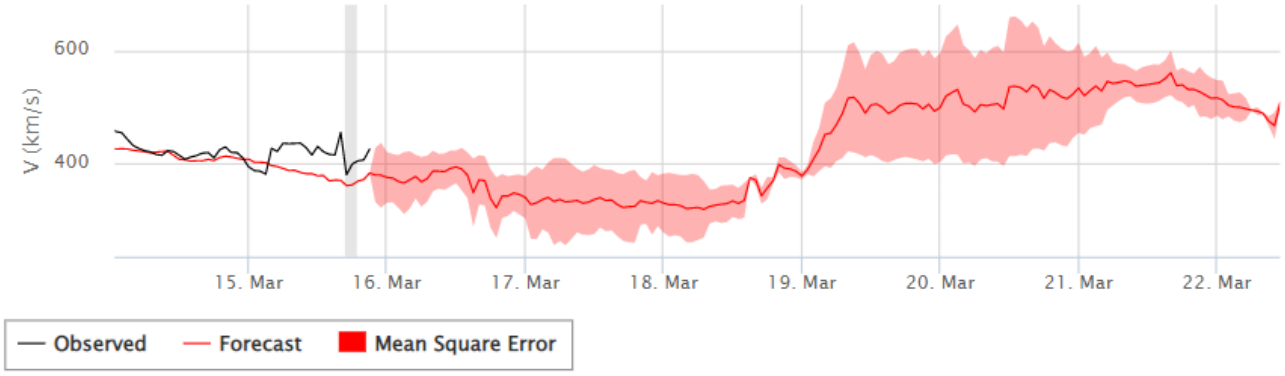
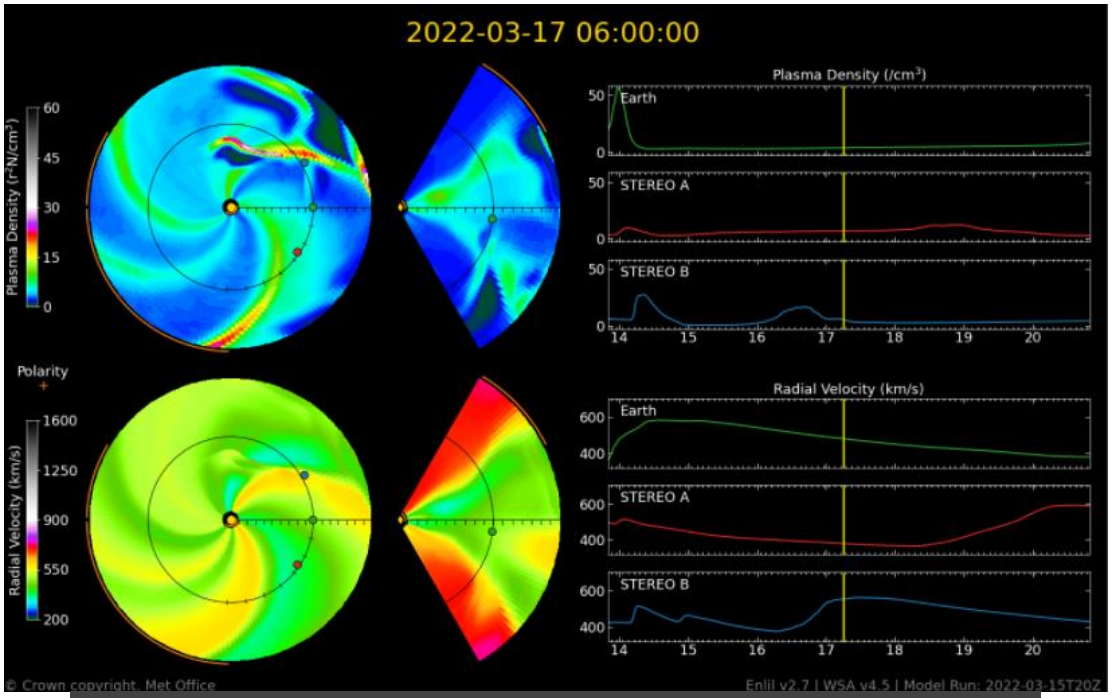
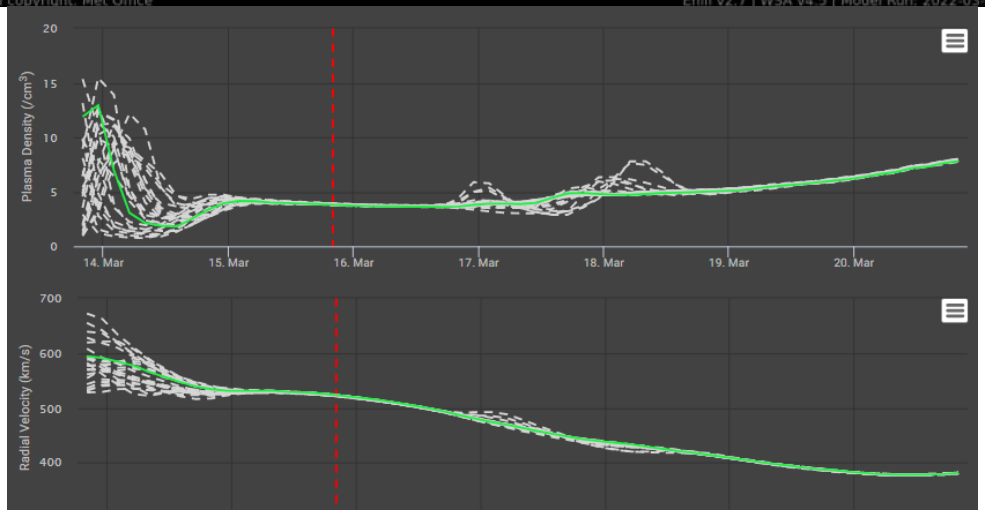


Figure 4: Enlil with ensemble, showing slight chance of glancing blow of CME from the 13th on the 17th.





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Radio Blackouts - X-Ray Flares:

Solar Activity is currently Moderate with three numbered sunspot regions on the visible disc. AR2965 Fai/Beta-Gamma, just west of the north-centre disc has been the source of the activity with 2 M-flares (M1.4 at 15/1239UTC and M1.6 at 15/2246UTC) and a number C-flares. This is a longitudinally wide region, consisting of numerous small spots and appears to have been destabalised by the emergence of new spots in close proximity to the north. Further M-flares are likely from this region.

All other regions, are much smaller and generally inactive. AR2967 Hsx/alpha and AR2970 Bxo/Beta are both faint and stable. AR2960 Hsx/alpha has recently rotated over the west limb, and is no longer viable. Whilst this could still be a source of flaring, it was inactive whilst on the disc. A further new, but small region appears to be developing near the northeast limb.

Activity is forecast to be Low to Moderate with a chance of further M-flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	50	40	30	30
Very Active	R3 to R5 X Class	No	5	2	2	2

Figure 5: GOES-16/17 X-ray Flux

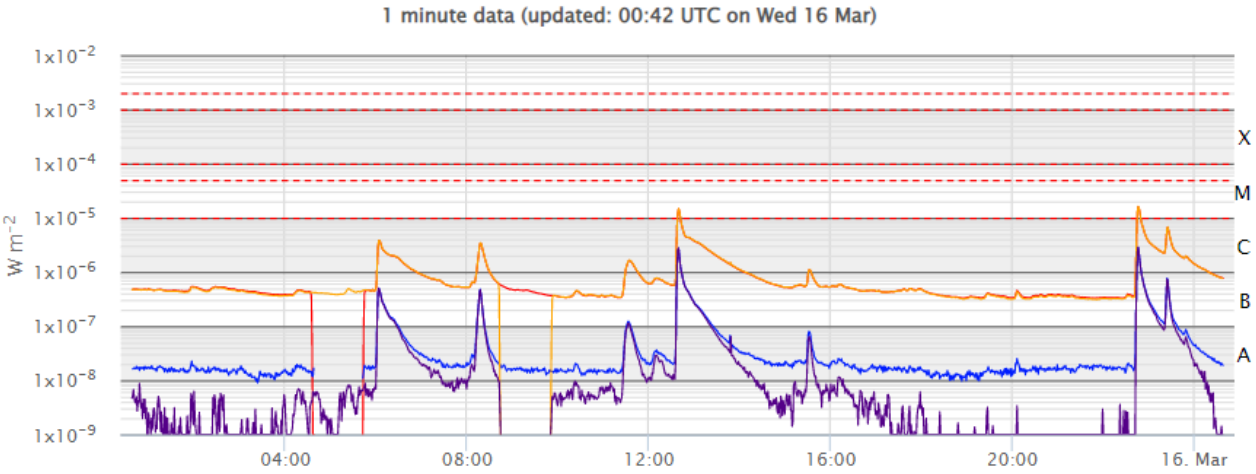

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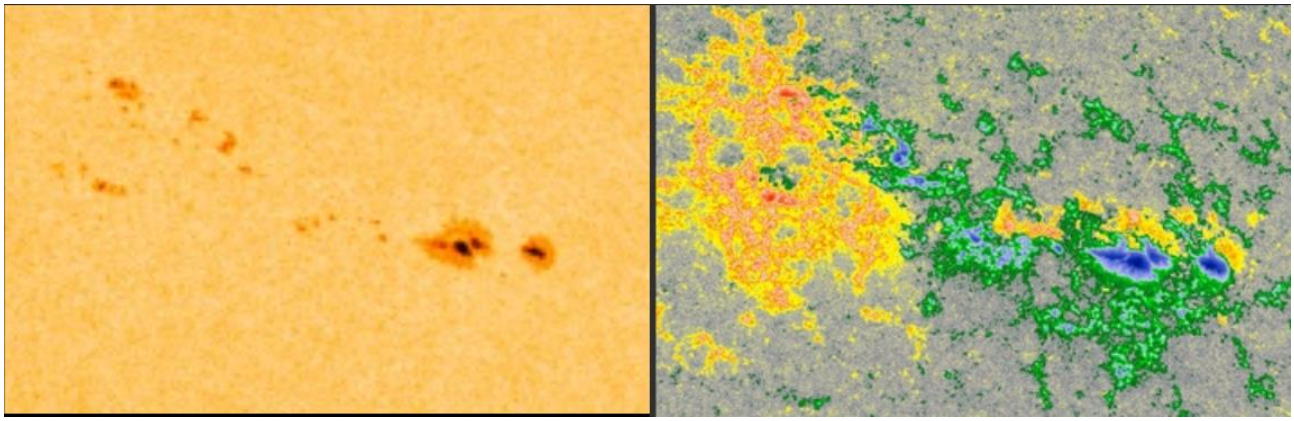
Figure 6: AR2965 Intensitygram (left) and Magnetogram (right). Original trailer appears to have declined, along with intermediate spots. However new emergences in north, still connected to AR2965 is likely source of instability.

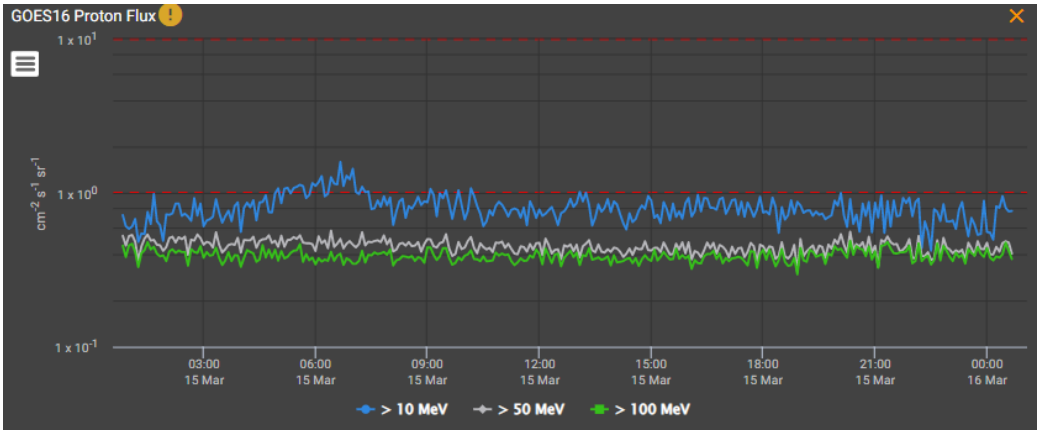


Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 slightly rose above background levels in the last 24 hours, likely due to a far-sided flare, with subsequent CME seen off the SW of the disc. This peaked at just over 1pfu, before declining back towards background, remaining well below the S1 level. Further such enhancements are possible from any large flares from AR2965, with only a slightly above background chance of reaching the S1 level. Otherwise background levels are expected to persist.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 7: Slight rise due to flare just over the Southwest limb, with subsequent CME observed.



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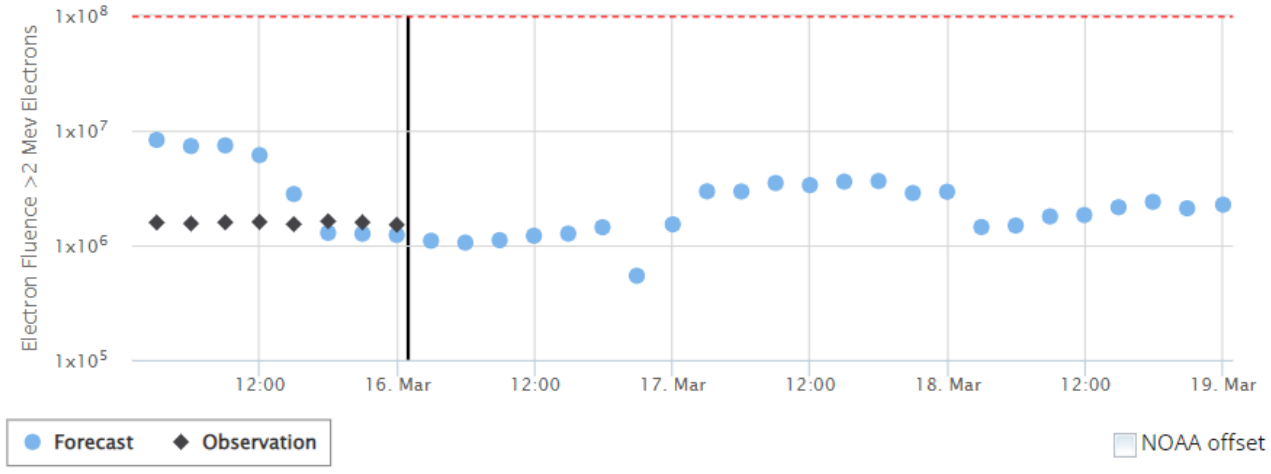
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at background levels. Recent CME arrival appears to have not increased flux levels at GEO, however there is still the potential for observed flux levels to build through day 1 and day 2 (16th and 17th), although this is very low confidence. No other sources of enhancement are currently expected in the period. The slight chance of a glancing CME day 2 (17th), decreasing this confidence further.

The associated 24 hour electron fluence is well below the Active level, and expected to remain at this level. This is supported by REFM, which is giving good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 8: GOES-16 >2 MeV Electron Fluence with REFM.



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